Watch This Space

Exploring Epigenetics

In addition to genetic information encoded by the DNA base sequence, it appears a whole new level of information is conferred by a variety of chemical modifications to the DNA and the histone proteins that it is wrapped around. These modifications are not permanent, but can be remodelled by nuclear enzymes to change the meaning of the information they encrypt. However, in some cases, the chemical attachments are relatively stable and remain through cell division to be inherited by the next generation. This higher level of information, known as 'epigenetics,' is a major factor in explaining how different cells express different patterns of genes, despite all carrying the same underlying genome. Specific molecular complexes in the cell nucleus are thought to 'read' the epigenetic 'code' to determine which genes should be expressed, though the rules that define the code are not yet fully known.

> **"Understanding this is a focus for many labs here in Cambridge"**

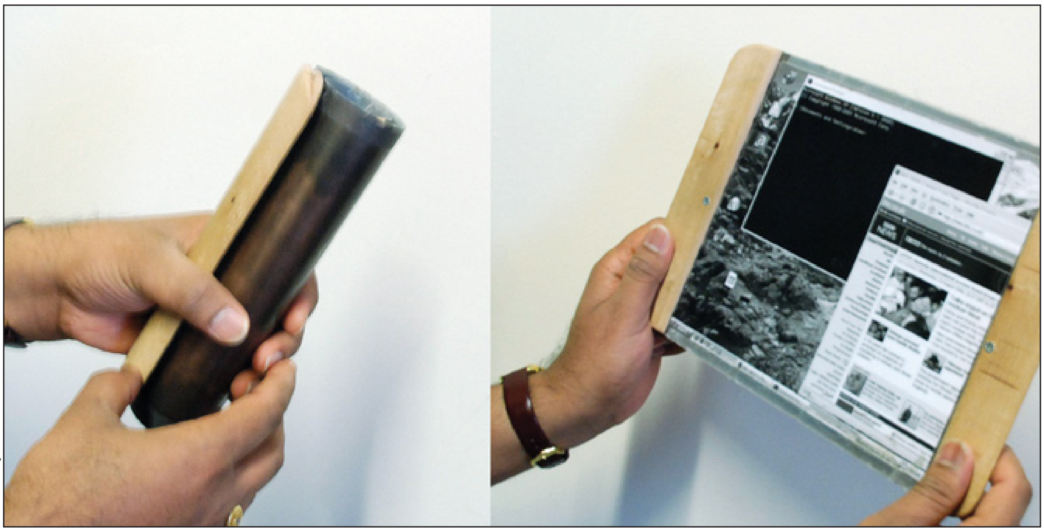
Just as many diseases are caused by gene mutations, disruptions to non-coding RNAs may be at the root of many diseases, including certain cancers, developmental disorders and neurodegenerative diseases. Understanding this is a focus for many labs here in Cambridge, both within the Department of Physiology, Development and Neuroscience, and Institutes such as Babraham and Gurdon. The sheer concentration and collaboration of these researchers working across Cambridge makes this an exciting area for potential biomedical breakthroughs. ■

Alice Young is a graduate working in the Genetics Department. She is an Editor for this 800th Anniversary Edition.

Morphing Structures

When we think of everyday structures, we tend to think of objects that are relatively solid: buildings and bridges are good examples of why they need to be, to withstand the loads the Nature applies to them through wind and gravity. But structures can also be movable: think of folding deckchairs, ironing boards, even car doors—all must have structural integrity yet provide some shape-changing or space-saving functionality. In the Engineering Department, the Advanced Structures Group is preoccupied with finding novel structures that change shape in a very dramatic and reversible way, but which have few of the moving parts found in objects such as deckchairs etc, for ultimate simplicity and ease of production. These structures can "morph" between isolated configurations to create extra purpose but without need of advanced, futuristic materials; Drs Keith Seffen and Simon Guest, who lead this research group, rely instead upon ordinary materials, such as metals and plastics. Morphing is made possible, for example, by embedding stresses inside the material during the manufacture of the structure, which creates the locking and driving forces necessary for holding and changing shape. One remarkable example is a bistable sheet, which can be either flat or coiled up like a tube. Electronics manufacturers are now making electronic screens so thin to be coilable, that Seffen and Guest are proposing to attach them to their sheet to create a robust bistable "roll-out" display for ultra compact laptops and mobile telephones, as shown in the mocked-up prototype. Patent-protected collaboration with industry is already underway. ■

> **"Novel structures that change shape in a very dramatic and reversible way"**



Courtesy of Keith Seffen

Dr Keith Seffen is a researcher in the Department of Engineering.

New Crop Design

The basic mechanism of photosynthesis is surprisingly inefficient, for the pathway that ultimately fuels almost all life on Earth. More than 50 times, however, evolution has overcome this limitation, developing a 'turbocharger' for photosynthesis, known as the C4 pathway.

The biochemical basis for this centres around RUBISCO, the key enzyme that grabs carbon dioxide and sticks it into organic molecules. RUBISCO cannot easily distinguish between CO^2 and oxygen. If it gets it wrong, and adds oxygen, the plant has to spend valuable energy sorting out the mistake. The C4 pathway also uses energy, but it pumps carbon dioxide towards RUBISCO, so that it has a better chance of doing the correct reaction.

> "Substantially increasing the yield of rice would have obvious benefits"

Maize uses the C4 pathway, as does Miscanthus, a grass which is now being studied for use in bioenergy. Rice, the staple diet of a third of the world's population, does not. Yet.

Dr Julian Hibberd, in the Department of Plant Sciences, is one of a number of researchers working towards genetically engineering rice to use C4 photosynthesis. Its many natural origins suggest that it's not too tricky to create, but the idea is still be an order of magnitude more complex than current GM crops.

Substantially increasing the yield of rice would have obvious benefits for tropical countries where food is short, and could also help to protect natural ecosystems (if you can get more food from a given area, you don't need to farm so much of the land). Bill Gates is putting money into the attempt to create C4 rice, and the prestigious journal Nature recently named Dr Hibberd as "One of five crop researchers who could change the world." ■

Courtesy of Julian Hibberd

Thomas Kluyver is a second year studying Biological Natural Sciences at Peterhouse College. He is Editor-in-Chief for the Science in Society Review.

'Mind-reading' Machines

What are you thinking? You may not realise it but your emotions are easier to read than you are aware. People effectively read each others minds all the time through the interpretation of gestures, facial expressions and vocal intonations. The ability to predict the actions of others by attributing particular mental states to certain observable behaviour is known as the 'theory of mind'. This social ability is often used as a distinction between purely human interactions and those with a computer. However, a team in the Computer Laboratory at the University of Cambridge has been developing emotionally intelligent 'mind-reading' machines, potentially blurring this boundary. Work is being done in collaboration with a major motor manufacturer on developing a computer system that can detect the emotional state of a car driver. Many people would argue sat-navs have made driving an increasingly easier activity. However, in heavy traffic drivers can become overloaded with information and so interpreting the advice given by the navigational system can become a hindrance rather than a help. The team at the Computer Laboratory are developing emotionally aware systems that will be able to detect when a driver is feeling confused, drowsy or distracted and adjust the car's telematic systems appropriately. This is just one example of the projects being run at the Computer Laboratory that have the potential to dramatically change how we view computer technology in the future. ■

> "Your emotions are easier to read than you are aware"

Rosa Sharp is a second year studying Physical Natural Sciences at Downing College. She is the Managing Editor for this 800th Anniversary Edition.